On some Therapeutical Applications of Continuous Current.

A Paper read before the

THERAPEUTICAL SOCIETY, Apothecaries Hall,

London, 25th October, 1904,

BY

ARTHUR HARRIES, M.D.,

Fellow of the Society; formerly Physician to and Lecturer on Clinical Dermatology at St. John's Hospital for Diseases of the Skin (1884—1888):

AUTHOR of

"Cataphoric Medication" (***Med. Press & Circ.***, 1889).

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"Electrolysis in Treatment of Stricture of Urethra" (***Brussels Med. Grad. Association***, 1891), **&c., &c.**

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"Lectures on Lupus" (***Bailliere, Tindall, & Cox***, 1885).

"Manual of Electro-Therapeutics" (***Nursing Record Series***).

"Alternating *v.* Continuous Currents—Battery-produced" (***Trans. Inst. Electl. Engineers***, 1890).

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INTRODUCTION.

To my Readers,

The many requests for copies which I have received from medical friends, must be my excuse for reproducing this Paper.

With the kind permission of the Secretary to the Therapeutical Society, therefore, I am issuing a limited Edition in pamphlet form, trusting that any criticism it may receive will at least be unprejudiced.

It is merely introductory to, and suggestive of, the systematic treatment of many lesions by continuous current. Especially is it intended to emphasise the results to be expected in the treatment of early cases of Lupus, and of other superficial neoplasmata.

The failures of spasmodic or fragmentary attempts, frequently under indefinite conditions, can by no means be allowed to discredit the undoubted powers of continuous current as a therapeutical agent of immeasureable value.

ARTHUR HARRIES, M.D.

30, St. James's Square,

Pall Mall, S.W.,

London,

3rd November, 1904.

On some Therapeutical Applications of Continuous Current.

Mr. President, Gentlemen,

In venturing to accept the courteous invitation of your Secretary to read a paper before this Society, distinguished for its association with the home of accuracy, I have thought it best to restrict my observations to such applications of the therapeutical powers of electricity as are capable at least of approximate dosage.

In previous joint-papers, read at the Institution of Electrical Engineers,[1] and before Section G at the British Association meeting held at Leeds in 1890,[2] I have dealt with the resistances offered by the living human skin relatively to continuous and to alternating currents, both battery-produced and dynamo-produced, and for various reasons, which would take too long to set forth to-day, decided many years ago to concentrate my investigations chiefly on the therapeutical effects of the applications of current obtained by the use of batteries connected up either in parallel or in series

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(1). Journal I.E.E., Vol. XIX., No. 86.
(2). Trans. B.A., Leeds, 1890.

Accordingly, all the examples that I am about to give you, have been obtained with the aid of continuous current (battery-produced), under the following conditions :—

Conditions.

(*a*) The areas and sites of contact of the electrodes have been reasonably suited to the immediate purposes in view. That is to say, that in some cases large or small, flat or rounded, electrodes (covered with flannel or chamois leather), and in others bare metal electrodes of suitable shape and arrangement, have been employed.

The question of area of contact is especially important, inasmuch as the quantity of continuous current passing through a given resistance bears a close relationship to this factor.

Area of Contact.

(*b*) The period of soakage, and the fluid employed for such soakage, next demand attention. Resistance has been found to vary inversely as the time of contact, with any particular medium. Thus, the late Mr. Lant Carpenter discovered, in some of his experiments, that the resistance of the body from foot to foot varied from 10,300 ohms (with dry skin) at the moment of contact, to 4,300 ohms at the end of one minute's soakage with salt and water; and to 1,400 ohms at the end of 30 minutes' of such soakage. These broad results have been confirmed by many experiments referred to in the joint papers already quoted

[1] and [2] and by subsequent observations in my own practice.

(*c*) That there shall invariably be a calibrated milliampèremeter in circuit, because

(1) The E.M.F. of batteries constantly diminishes with time, and with the employment of the cells:

(2) Resistance of the skin varies largely in different individuals, as well as in the same individual, at different times and at different parts of the body:

(3) Further, the total body-resistance to be overcome varies, naturally, with the distance between the electrodes, with their absolute area, and with their area relatively to each other.

(*d*) It is scarcely necessary to add that the whole apparatus should be tested as to its efficiency previously to each application.

m of age.

The effects of soakage depend largely upon the solution employed. Thus, distilled water has a relatively high internal resistance as compared with tap water, while a 5% salt solution has a very much lower internal resistance as compared with the latter, though itself shewing a higher internal resistance than a 5% solution of iodide of potassium.

These percentage strengths are, of course, only named for the purposes of comparison.

Early Experimental Failures.

I must ask your indulgence for having reminded you, Gentlemen, of these essentials. Both in the United States and in this country, tentative experiments, under defective conditions, have naturally resulted unfavourably. In some of the text-books, the authors have even been rash enough, on what I venture to consider insufficient grounds, to consign the continuous current and all its applications to comparative oblivion.

My object, therefore, is to endeavour to show you, by a series of selected cases, that, when accurately employed, continuous current has valuable therapeutical powers.

Many of you present may recall that, some twenty years or so ago, similar hasty and erroneous deductions were drawn from the partial failure of the attempts made to employ electricity for lighting purposes. It is not necessary to follow the parallel further.

Functions of Continuous Current.

The functions of continuous current which immediately concern us may be divided as follows :—

i. Mechanico-physical (Cataphoresis).
ii. Electro-chemical (Electrolysis).
iii. Electro-physiological (Catalysis).

Each of these is, of course, capable of sub-division, and many of these sub-divisions will occur to you.

It may be added that my work is based largely upon the theory of the dissociation of electrolytes into anions and kations when a continuous current is passed.

I have selected the following typical cases to illustrate these functions. In every instance, the diagnosis has been made by independent medical men, and nearly always in these cases treatment has been carried out in presence of members of the profession other than myself.

Cataphoresis.

e 1. *To illustrate Cataphoric Anæsthesia.*

Mr. H., 58, a case of Rachialgia, diagnosed by the late Dr. Charcot, and ordered by him to undergo repeated applications of galvano-cautère to the region of the lower cervical and upper dorsal spine.

The patient had a dilated right heart and other cardiac insufficiency, and it was not deemed prudent to give him a general anæsthetic.

His son-in-law, a medical man, came with him to me, and it was decided to carry out Dr. Charcot's suggestion.

The skin, having been first soaked with 5% salt and water solution for 20 minutes, was subjected over an area of 30 cm. by 10 cm. during half-an-hour, along one side of the lower cervical and upper dorsal spine, to the action of a continuous current.

Thirty to forty ma. were passed through a flannel-covered anodal electrode, saturated with a 10% solution of hydrochlorate of cocaine.

The kathodal electrode—twice the area of the anodal—soaked in 5% salt and water solution, was placed upon the lower front of thorax and upper epigastrium.

Six galvano-cautère linear scarifications, each five centimetres long by half-a-centimetre deep, were made opposite as many intervertebral spaces. In *The Lancet* of October 25th, 1890, page 869, in describing this case, I stated :—

> "The patient did not flinch, but expressed his perfect "willingness to undergo a similar operation again if "necessary."

This, in fact, he did on two subsequent occasions, the results as regards painlessness being similar.

The persistent objection to cataphoric medication is, that we have no ready means of estimating the actual quantity of drugs passed through the skin.

> "But as a matter of probability, and of experience in a "good many cases, the quantity passed is really very "small, though it is sufficient so to anæsthetise the "skin as to render it capable of bearing, without "difficulty, contact with a white-hot platinum wire, "heated by the electric current. Further than this, "no immediate after pain or sense of burning was "experienced in the parts submitted to operation, "though it is not certain that this is due to cocaine

"alone. I have noticed similar freedom from pain
"*after* applications of the galvano-cautère under
"chloroform. In every instance in which I have
"employed cocaine by cataphoresis, careful enquiry
"has been made as to the existence of after-toxic
"symptoms, always with a negative result."

Three sets of operations were undertaken, each being carried through in the manner described above. These were:—

(1) Six scarifications on the right side:

(2) After an interval of five days, six corresponding scarifications on the left side: and

(3) After a further interval of ten days, six intermediate scarifications joined the lateral sets.

There was no shock at any stage of the procedure: no unpleasant sequelæ; and the ultimate results were satisfactory.

2. *To illustrate Cataphoric Medication.*

Miss B., 39, had suffered for six years or longer from arthritic fixation of practically all the joints of both upper and lower extremities. These had been repeatedly broken down at a County Hospital, but had as frequently relapsed into the old condition. The patient could neither walk, feed herself, nor help herself in any way involving movement of the limbs.

So many joints needing attention, a series of operations was necessary, and each of these was carried out in presence of several medical men. On the first day, I broke down, under chloroform, twenty-seven joints of the upper extremities, in such a way as to admit of free movement. Subsequently a ½% solution of iodine in aqueous iodide of potassium was passed directly into the joints by the aid of suitably-arranged anodal electrodes, a current of 30 ma. being used. The application was employed and repeated for periods of half-an-hour twice a day, during a series of days. The kathodal electrode was of approximately twice the area of the anodal, and was in contact with a proximal portion of the same limb.

Each cataphoric application was preceded by soakage as in case 1, and succeeded by passive movements of the particular joints under treatment.

Similar procedure was adopted in the repeated subsequent operations, viz. : (*a*) breaking down under chloroform ; (*b*) soakage ; (*c*) cataphoric medication with the iodine solution described ; (*d*) passive movements.

At the end of three weeks, the majority of the affected joints had been brought into use, and the patient was able to feed herself and to knit quite comfortably. The larger joints of the lower extremity were about to be dealt with, when the patient objected to further treatment because, as she informed the nurse, it would mean that she would be well enough to work for her living. This was apparently the last thing she desired, as she had for years been an object of charity.

Before turning to another function of the continuous current, I may be permitted to quote further from the paper in *The Lancet*, to which I have above referred.

I have used cataphoric medication in the practical and frequently successful treatment of many skin lesions, as well as arthritic, syphilitic, glandular, and other affections.

> "The plan is not new (1890), for it was introduced as a "physiological experiment some years ago in Germany: "but so far as I am aware, such previous attempts as "have been made in this country to bring cataphoresis "into practical use have been only partially successful, "because (1) the requisite conditions have been neglected; (2) the currents used have been too feeble, and "applied for too short a time; (3) the operators seem "to have been lacking in patience, and often in knowledge, of the instruments employed; (4) the reversals "recommended in the text-books are not only useless, "but worse than useless, for they tend to counteract "any movement of fluid in a particular direction which "may already have been set up by the current.
>
> "Cataphoric medication is indicated in many cases hitherto "laboriously treated by ointments, lotions, and subcutaneous injections, and it is not to be doubted that "by its agency we are able to bring our remedies into "direct apposition with the actual sites of disease, and "thus to increase the possibilities of successful treatment of many lesions, not only in the direction of "rapidity, but in that of pleasantness and of safety."

The experience of many cases of cataphoric medication during the years that have intervened since the date of this paper (1890) has served to confirm and to

emphasize the conclusions which I then brought to the notice of the profession. In the *Medical Press and Circular* of December, 1889, I had previously described the method adopted in such cases.

C.C. from the main would conceivably be of much service in cataphoric applications, but of this I have no experience.

Case 3. *To illustrate Electrolysis.*

Mr. L., about 38 years of age, had been suffering from stricture of the urethra for many years, and when I saw him at the Doncaster Infirmary, in consultation with Dr. Christy Wilson and several of his colleagues, there had been retention of urine for some 30 hours. The patient and his friends had declined to allow any cutting operation to be done, and it was decided to attempt to pass a bougie-electrode into the bladder.

An anodal pad, 15 cm. by 10 cm., soaked in 5% salt and water solution, was placed over the lower part of the abdomen, and a rheophore connected with the negative pole of the battery was in readiness to be connected up with the bougie-electrode when in position.

A No. 3 (English gauge) was first used, and passed without resistance for about 4 inches, when further passage was interfered with by the stricture. It was then connected up with the rheophore, and a current, beginning with 5 ma., and increasing slowly to 10 ma. was passed through.

Gentle pressure soon carried the electrode through the resistance, and with two or more short stoppages, due to additional contractions, the bougie was passed into the bladder, when the current was immediately switched off.

The electrode was now withdrawn, and metal terminals of increasing size were similarly passed without any great difficulty into the bladder by aid of a 10 ma. current, until a No. 8 (English) had gone through.

The full time occupied was ten minutes, and Dr. Wilson easily passed a No. 8 catheter.

se 4. *To illustrate Electrolysis and Catalysis.*

Mr. B.H.F., 44, born in South Africa of British parents, was in the habit, from time to time, of making long expeditions for large game hunting into the interior of Central South Africa.

The last expedition prior to my seeing him had entailed some six months of practical living in the saddle. The latter part of his journey was marked by prostatic pains, which persisted after the end of the expedition. These pains were succeeded by the usual signs of prostatic obstruction, including the necessity for frequent micturition at night. Treatment in South Africa failed to relieve the patient.

He consequently came to England and consulted consecutively two eminent Surgeons, since deceased.

Each of these gentlemen diagnosed prostatic enlargement, and each advised a suprapubic operation for its relief.

On examination per rectum, I found general enlargement, with slight tenderness over the middle lobe, and the prostatic urethra only allowed a bougie equal to No. 6 (English) to pass. No urine came away from the bladder until the eye of a catheter had been passed over eight inches.

It was arranged to give the patient a series of sittings with the bougie-electrode. Commencing with a No. 6 passed into the prostate, connected with the negative pole of the battery, and using a current of 7 to 8 ma. for a period of twelve minutes on alternate days, I found that, after ten sittings, a full-sized bougie-electrode could be comfortably passed.

The necessity for nocturnal micturition had disappeared, as well as all tenderness of the prostate, and the latter was now almost normal in size.

Three subsequent sittings were given of similar type, and the patient went home practically well.

Notes. The early development of prostatic enlargement in this case, as the result of pressure and irritation set up by continuous riding, may possibly account for the rapid manner in which electrolytic treatment caused disappearance of the conditions.

It is, however, only right to add that several subsequent cases of enlarged prostate, developing at the normal age (55—65) and similarly treated, have also done well.

Electrolysis in the Treatment of Neoplasmata.

Twenty years ago, at St. John's Hospital for Diseases of the Skin, I undertook many operations of the usual type for the treatment of Lupus. At more than one of these operations, a well-known Bacteriologist attempted to obtain cultures of the lupus baccillus by passing lupus nodules direct from the living subject into the culture solutions. His efforts, however, met with no success, and subsequently a colleague and I attempted the same thing under conditions of temperature and culture fluids, approximating as nearly as possible to those found in the living body, equally without success. We also made microscopical sections of frozen lupus nodules, and found the baccilli, indeed, but few in number and deeply placed.

Former methods, such as plugging with germicides the spaces left after scraping or punching out the nodules, met with a fair measure of success in cases of early development. Where recurrence took place, was when the scraping or punching had not been carried deeply or widely enough, and when, consequently, the germicide had not come into direct contact with the whole of the basal portions of the nodules.

These repeated experiences suggested to me a possibility that the passage of an electrolytic needle along the base of each nodule might be of some use. Accordingly, in many cases where early developments in the shape of apple-jelly nodules were present, whether alone, or accompanying patches of deeper destruction of tissue, I passed a platinum needle under the base of each nodule, adopting this method, first of all, in the case of a nurse from the North Western Fever Hospital, sent to me by Dr. Gayton.

The needle was made the cathode of a c.c, battery, and the anode was a pad of varying area (from 50 to 150 sq. centimetres) placed conveniently near. A current of from 5 to 10 ma. was usually passed for a period of two minutes, tranverse passages being made. The operations, in most instances, were repeated twice a week. The nodules became red, somewhat swelled and slightly tender.

Subsequently to the third or fourth applications shrinkage began to take place, and the nodules in many cases disappeared, leaving only superficial cicatrices.

In cases of polypus, villous papillomata, warts, external hæmorrhoids, and other superficial developments, I have frequently found equally beneficial results, and in cases of nœvus, of the superficial type especially, the effects have sometimes been startling.

In conclusion, the cases cited are merely examples of the many purposes for which I have employed the

continuous current, and where, in the hands of practitioners, whether in America or at home, unpleasant results, such as inflammations or disappointing factors of other kinds, have supervened, I am compelled by the experience of many years to think that there must have been something wrong in the apparatus employed or in the manner of using it. I trust that some of you present may be at least inclined to give a fair trial to a therapeutical agent of vast possibilities, cleanly, practically painless, and very largely efficient, easily portable and capable of approximately accurate measurement.